GS1086L

1.5A Low Dropout Voltage Regulator

Product Description

The GS1086L is a low dropout three-terminal regulator with 1.5A output current capability. In order to obtain lower dropout voltage and fast transient response, this is critical for low voltage applications. The GS1086L has been optimized.

The device is available in an adjustable version and fixed output voltage of 1.5V, 1.8V, 2.5V, 3.3V and 5V. Dropout voltage is guaranteed at a maximum of 1.3V at 1.5A.

Current limit is trimmed to ensure specified output current and controlled short circuit current.

On-chip thermal limiting provides protection against any combination of overload that would create excessive junction temperatures.

The GS1086L is available in the three leads SOT-223, TO-252 and TO-263 surface mount packages.

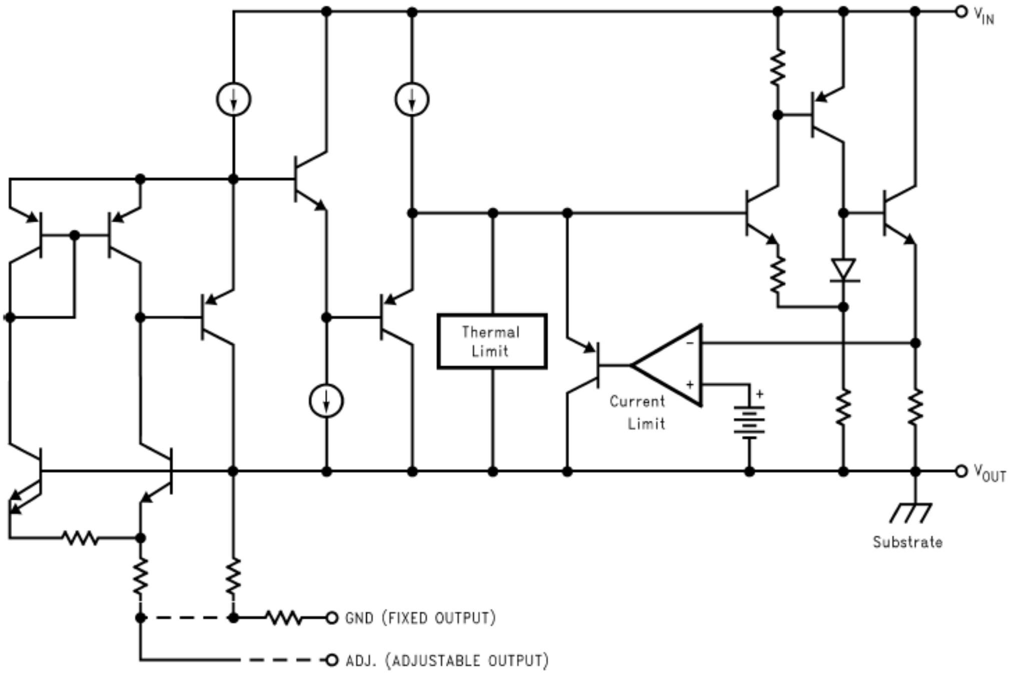
Features

- Adjustable or Fixed Output
- Current Limit and Thermal Protection
- Output Current of 1.5A
- 1.3V Dropout Voltage
- Line Regulation typically at 0.04% Max.
- Load Regulation typically at 0.2% Max.

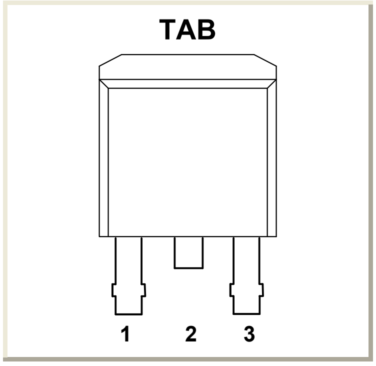
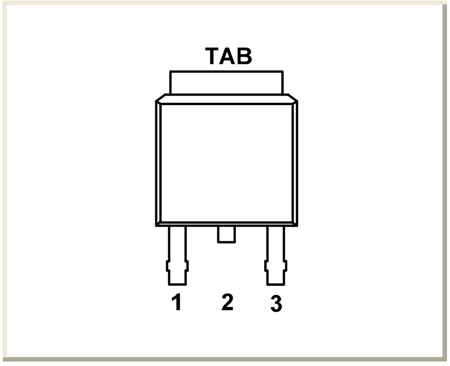
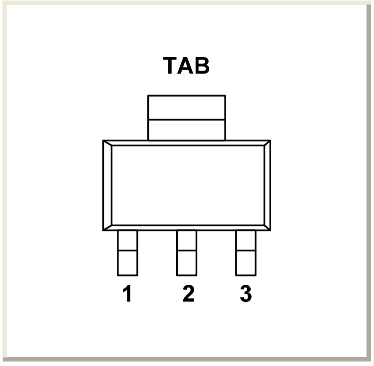
Applications

- Battery-Power Circuitry
- Post Regulator for Switching Power Supply
- Low Voltage Logic Suppliers

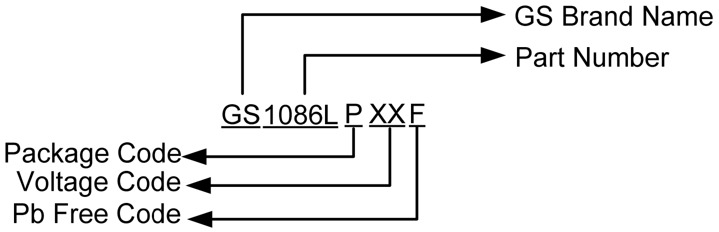
Block Diagram



Packages & Pin Assignments

GS1086LM (TO-263)		GS1086LD (TO-252)		GS1086LX (SOT-223)	
					
1	GND/ADJ	**1**	GND/ADJ	**1**	GND/ADJ
2	V_{OUT}	**2**	V_{OUT}	**2**	V_{OUT}
3	V_{IN}	**3**	V_{IN}	**3**	V_{IN}

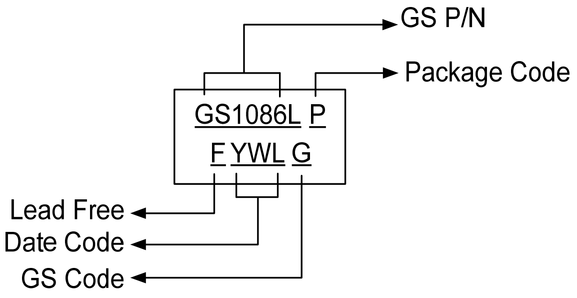
Ordering Information

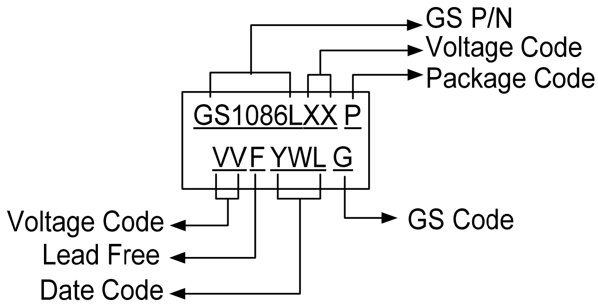


TO-263	**TO-252**	**SOT-223**	**Output**
GS1086LM	GS1086LD	GS1086LX	ADJ
GS1086LM15	GS1086LD15	GS1086LX15	1.5V
GS1086LM18	GS1086LD18	GS1086LX18	1.8V
GS1086LM25	GS1086LD25	GS1086LX25	2.5V
GS1086LM33	GS1086LD33	GS1086LX33	3.3V
GS1086LM50	GS1086LD50	GS1086LX50	5.0V

Adjustable Version does not need Voltage Code.

Marking Information





Absolute Maximum Ratings

Symbol	**Parameter**	**Maximum**	
V_{IN}	Input Voltage	15V	
θ_{JC}	Thermal Resistance (Junction to Case)	TO-263	3ºC /W
		TO-252	5ºC/W
		SOT-223	15ºC/W
θ_{JA}	Thermal Resistance (Junction to Ambient)	TO-263	62.5ºC/W
		TO-252	90ºC/W
		SOT-223	160ºC/W
P_D	Internal Power Dissipation	Internally Limited	
T_J	Operating Junction Temperature	-40ºC to 125ºC	
T_{STG}	Storage Temperature Range	-65ºC to 150ºC	
T_{LEAD}	Lead Temperature (10 sec)	260ºC	

Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions above those indicated in the operation sections of the specifications is not implied.
Exposure to Absolute Maximum Ratings conditions for extended periods may affect device reliability.

Electrical Characteristics

I_{OUT} = 0 mA, and T_J = +25°C, unless otherwise noted

Parameter	Device	Conditions	MIN	TYP	MAX	Unit
Reference Voltage (Note3)	GS1086L	V_{IN} =2.75V, I_{LOAD} =10mA	1.238	1.250	1.262	V
		*V_{IN} =2.7V to 12V, I_{LOAD} =10mA to 1.5A	1.225	1.250	1.275	V
Output Voltage	GS1086L15	V_{IN} =4.0V	1.485	1.500	1.515	V
		*V_{IN} =3.0V, I_{LOAD} =10mA to 1.5A	1.476	1.500	1.524	V
	GS1086L18	V_{IN} =4.3V	1.782	1.800	1.818	V
		*V_{IN} =3.3V, I_{LOAD} =10mA to 1.5A	1.771	1.800	1.829	V
	GS1086L25	V_{IN} =5.0V	2.475	2.500	2.525	V
		*V_{IN} =4.0V, I_{LOAD} =10mA to 1.5A	2.460	2.500	2.540	V
	GS1086L33	V_{IN} =5.8V	3.267	3.300	3.333	V
		*V_{IN} =4.8V, I_{LOAD} =10mA to 1.5A	3.247	3.300	3.353	V
	GS1086L50	V_{IN} =7.5V	4.950	5.000	5.050	V
		*V_{IN} =6.5V, I_{LOAD} =10mA to 1.5A	4.900	5.000	5.100	V
Line Regulation **(Note1)**	All	*I_{LOAD} =10mA, (1.5V+V_{OUT})≤V≤12V		0.04	0.2	%
Load Regulation **(Note1)**	All	*V_{IN} = V_{OUT}+1.5V, I_{LOAD} =10mA to 1.5A		0.2	0.4	%
Minimum Load Current	GS1086L	*V_{IN} =5V, V_{ADJ} =0V		3	7	mA
Ground Pin Current	GS1086L-XX	*V_{IN} = V_{OUT}+1.5V, I_{LOAD} =10mA to 1.5A		7	13	mA
Adjust Pin Current	GS1086L	*V_{IN} =2.65V to 12V, I_{LOAD} =10mA		55	90	µA
Current Limit	All	*V_{IN}- V_{OUT}=1.5V	1.5	2.2		A
Ripple Rejection **(Note 2)**	All	V_{IN} = V_{OUT}+1.5V,	60	65		dB
Dropout Voltage **(Note 1,3)**	All	I_{LOAD} =10mA		1.00	1.15	V
		*V_{IN}≥2.65V, I_{LOAD} =1.5A		1.3	1.5	V
Temperature Coefficient	All	*V_{IN} =V_{OUT}=1.5V, I_{LOAD} =10mA		0.005		%/ºC

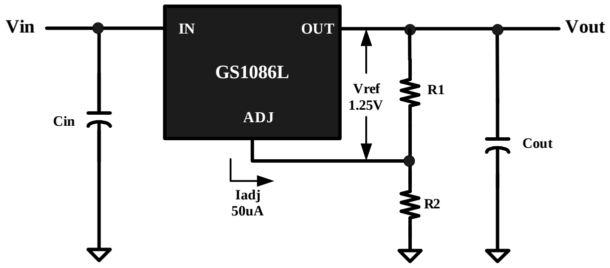
The ***** denotes the specifications which apply over the full temperature range.

Note 1: Low duty pulse testing with Kelvin connections required.

Note 2: 120Hz input ripple (C_{ADJ} for ADJ=25µF)

Note 3: ΔV_{OUT}, ΔV_{REF}=1%

Typical Applications



$V_{OUT}=V_{REF}\,(1+R2/R1)+I_{ADJ}R2$

Figure1. Adjustable Voltage Regulator

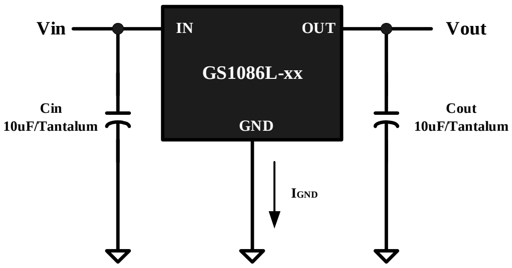
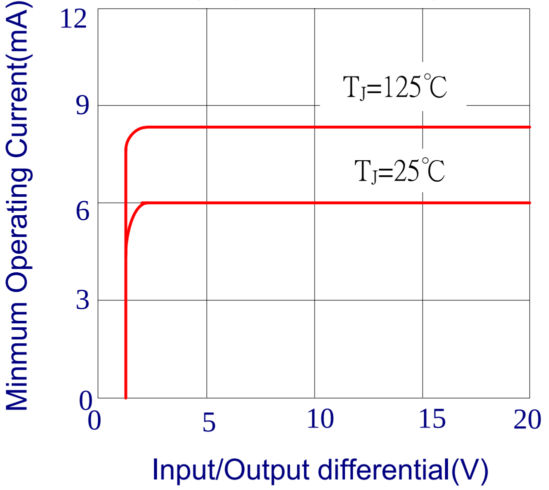


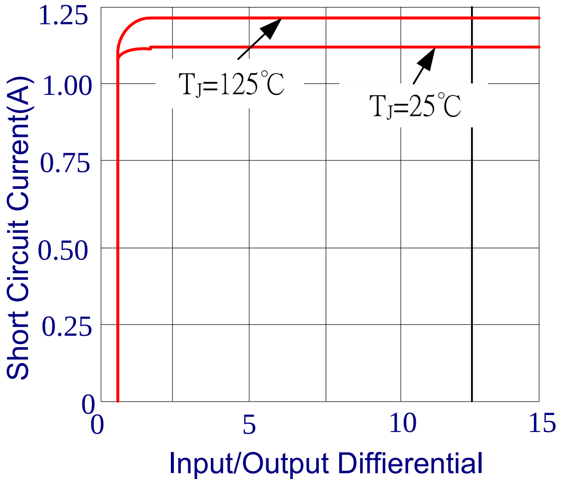
Figure2. Fixed Voltage Regulator

Typical Performance Characteristics

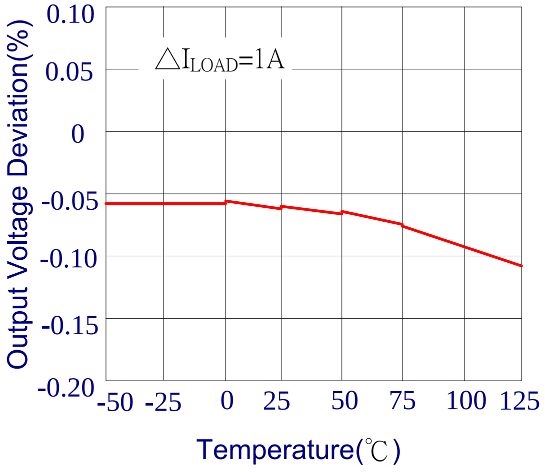
Minimum Operating Current
(Adjustable Device)



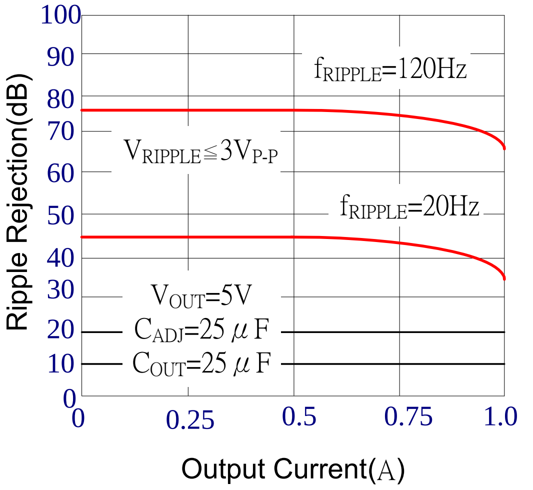
Short-Circuit Current



Load Regulation



Ripple Rejection vs.Current



Application Hints

The GS108X series of adjustable and fixed regulators are easy to use and are protected against short-circuit and thermal overloads. Thermal protection circuitry will shut-down the regulator should the junction temperature exceed 165℃ at the sense point.

Pin compatible with older three terminal adjustable regulators, these devices offer the advantage of a lower dropout voltage, more precise reference tolerance and improved reference stability with temperature.

Stability

The circuit design used in the GS108X series requires the use of an output capacitor as part of the device frequency compensation. The addition of 22μF solid tantalum on the output will ensure stability for all operating conditions.

When the adjustment terminal is bypassed with a capacitor to improve the ripple rejection, the requirement for an output capacitor increases. The value of 22μF tantalum covers all cases of bypassing the adjustment terminal. Without bypassing the adjustment terminal smaller capacitors can be used with equally good results.

To further improve stability and transient response of these devices larger values of output capacitor can be used.

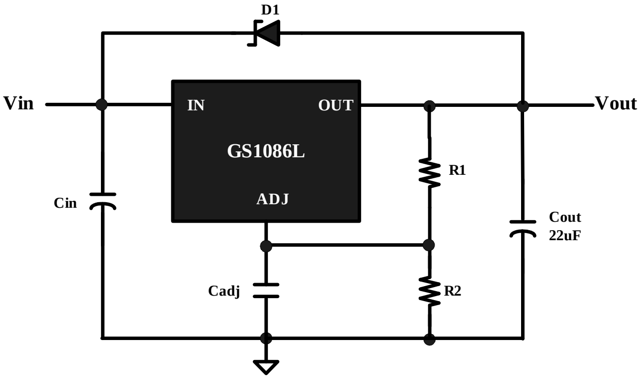


Figure 3.

Protection Diodes

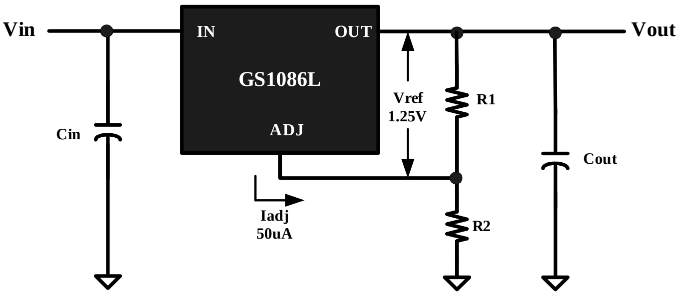
Unlike older regulators, the GS108X family does not need any protection diodes between the adjustment pin and the output and from the output to the input to prevent over-stressing the die. Internal resistors are limiting the internal current paths on the GS108X adjustment pin, therefore even with capacitors on the adjustment pin no protection diode is needed to ensure device safety under short-circuit conditions.

Diodes between the input and output are not usually needed.

Microsecond surge currents of 50A to 100A can be handled by the internal diode between the input and output pins of the device. In normal operations it is difficult to get those values of surge currents even with the use of large output capacitances. If high value output capacitors are used, such as 1000μF to 5000μF and the input pin is instantaneously shorted to ground, damage can occur. A diode from output to input is recommended, when a crowbar circuit at the input of the GS108X is used (Figure 3)

Output Voltage

The GS108X series develops a 1.25V reference voltage between the output and the adjust terminal. Placing a resistor between these two terminals causes a constant current to flow through R1 and down through R2 to set the overall output voltage. This current is normally the specified minimum load current of 10mA. Because I_{ADJ} is very small and constant it represents a small error and it can usually be ignored.



$V_{OUT}=V_{REF}(1+R2/R1)+I_{ADJ}R2$

Figure 4

Load Regulation

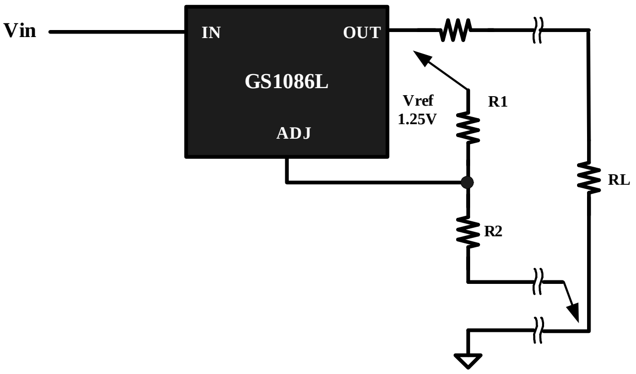
True remote load sensing it is not possible to provide, because the GS108X is a three terminal device. The resistance of the wire connecting the regulator to the load will limit the load regulation. The data sheet specification for load regulation is measured at the bottom of the package. Negative side sensing is a true Kelvin connection, with the bottom of the output divider returned to the negative side of the load.

The best load regulation is obtained when the top of the resistor divider R1 is connected directly to the case not to the load. If R1 were connected to the load, the effective resistance between the regulator and the load would be:

Rp x (R2+R1/R1) , Rp = Parasitic Line Resistance

Connected as shown, R_P is not multiplied by the divider ratio.

In the case of fixed voltage devices the top of R1 is connected Kelvin internally, and the ground pin can be used for negative side sensing.



*CONNECT R1 TO CASE
*CONNERT R2 TO LOAD

Figure 5

Thermal Considerations

The GS108X series have internal power and thermal limiting circuitry designed to protect the device under overload conditions. However maximum junction temperature ratings of 125ºC should not be exceeded under continuous normal load conditions.

Careful consideration must be given to all sources of thermal resistance from junction to ambient. For the surface mount package SOT-223 additional heat sources mounted near the device must be considered. The heat dissipation capability of the PC board and its copper traces is used as a heat sink for the device. The thermal resistance from the junction to the tab for the GS108X is 15ºC /W. Thermal resistance from tab to ambient can be as low as 30ºC /W.

The total thermal resistance from junction to ambient can be as low as 45ºC /W. This requires a reasonable sized PC board with at least on layer of copper to spread the heat across the board and couple it into the surrounding air. Experiments have shown that the heat spreading copper layer does not need to be electrically connected to the tab of the device. The PC material can be very effective at transmitting heat between the pad area, attached to the pad of the device, and a ground plane layer either inside or on the opposite side of the board. Although the actual thermal resistance of the PC material is high, the Length/Area ratio of the thermal resistance between layers is small. The data in Table 1, was taken using 1/16” FR-4 board with 1 oz. copper foil, and it can be used as a rough guideline for estimating thermal resistance.

For each application the thermal resistance will be affected by thermal interactions with other components on the board. To determine the actual value some experimentation will be necessary.

The power dissipation of the GS108X is equal to:

$$P_D = (V_{IN} - V_{OUT}) (I_{OUT})$$

Maximum junction temperature will be equal to:

$$T_J = T_{A\,(MAX)} + P_D \text{ (Thermal Resistance (junction-to-ambient))}$$

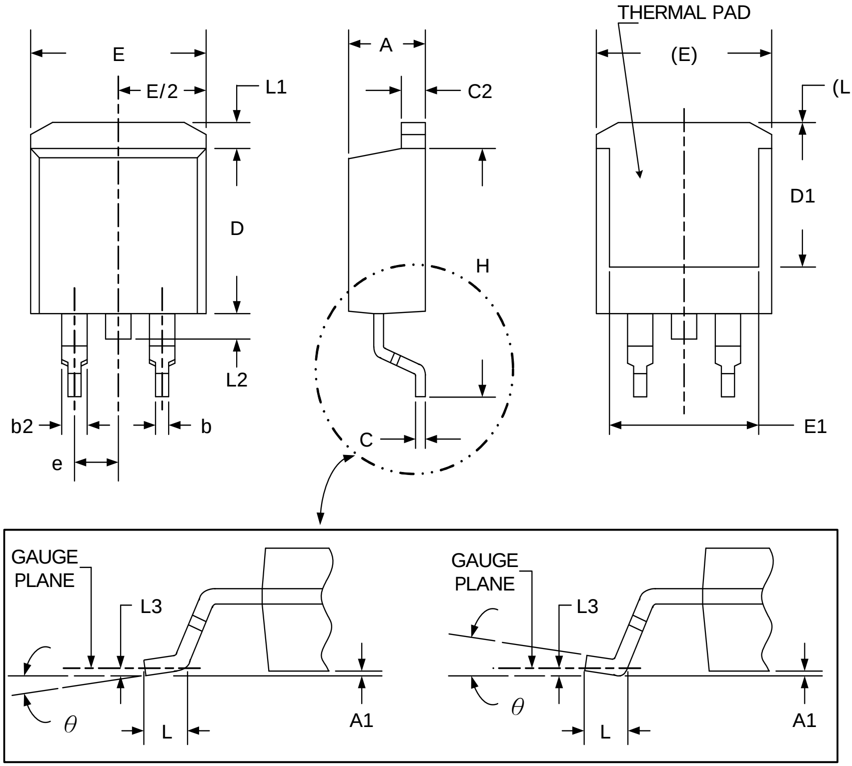
Maximum junction temperature must not exceed 125 ºC.

Ripple Rejection

The ripple rejection values are measured with the adjustment pin bypassed. The impedance of the adjust pin capacitor at the ripple frequency should be less than the value of R1 (normally 100Ω to 200Ω) for a proper bypassing and ripple rejection approaching the values shown. The size of the required adjust pin capacitor is a function of the input ripple frequency. If R1=100Ω at 120Hz the adjust pin capacitor should be ＞13μF. At 10kHz only 0.16μF is needed.
The ripple rejection will be a function of output voltage, in circuits without an adjust pin bypass capacitor. The output ripple will increase directly as a ratio of the output voltage to the reference voltage (V_{OUT}/ V_{REF}).

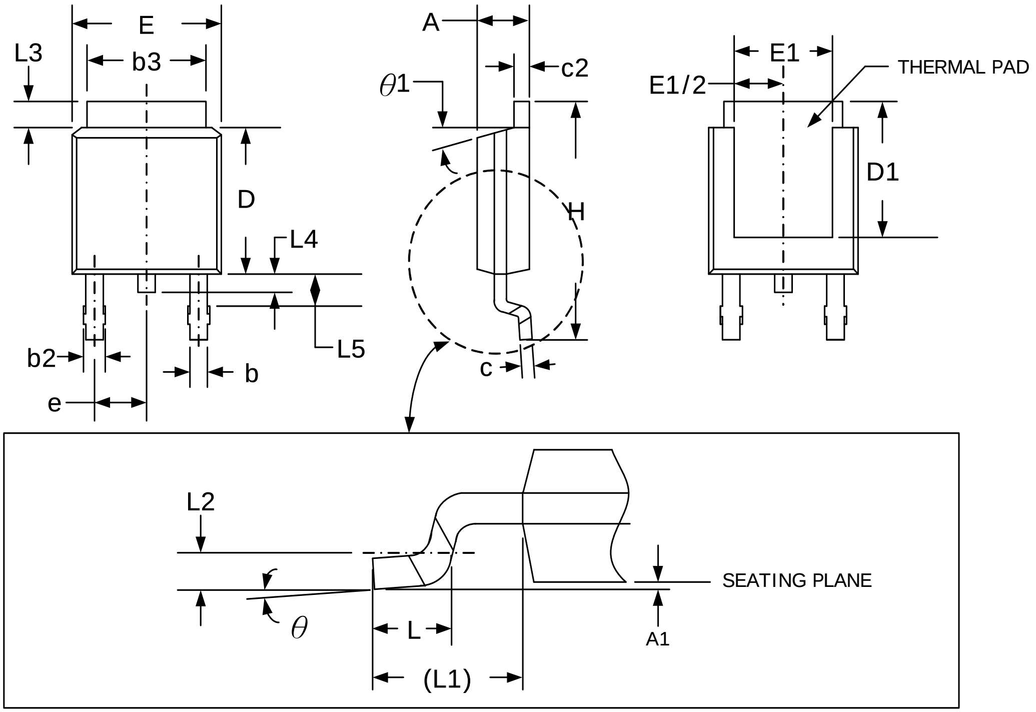
Package Dimension

TO-263 PLASTIC PACKAGE



Dimensions				
SYMBOL	Millimeters		Inches	
	MIN	MAX	MIN	MAX
A	4.06	4.83	.160	.190
A1	0	0.25	.000	.010
b	0.51	0.99	.020	.039
b2	1.14	1.78	.045	.070
C	0.38	0.74	.015	.029
C2	1.14	1.65	.045	.065
D	8.38	9.65	.330	.380
D1	6.86	-	.270	-
E	9.65	10.67	.380	.420
E1	6.22	-	.245	-
e	2.54 (TYP)		.100 (TYP)	
H	14.61	15.88	.575	.625
L	1.78	2.79	.070	.110
L1	-	1.68	-	.066
L2	-	1.78	-	.070
L3	0.25 (TYP)		.010 (TYP)	
θ	0°	8°	0°	8°

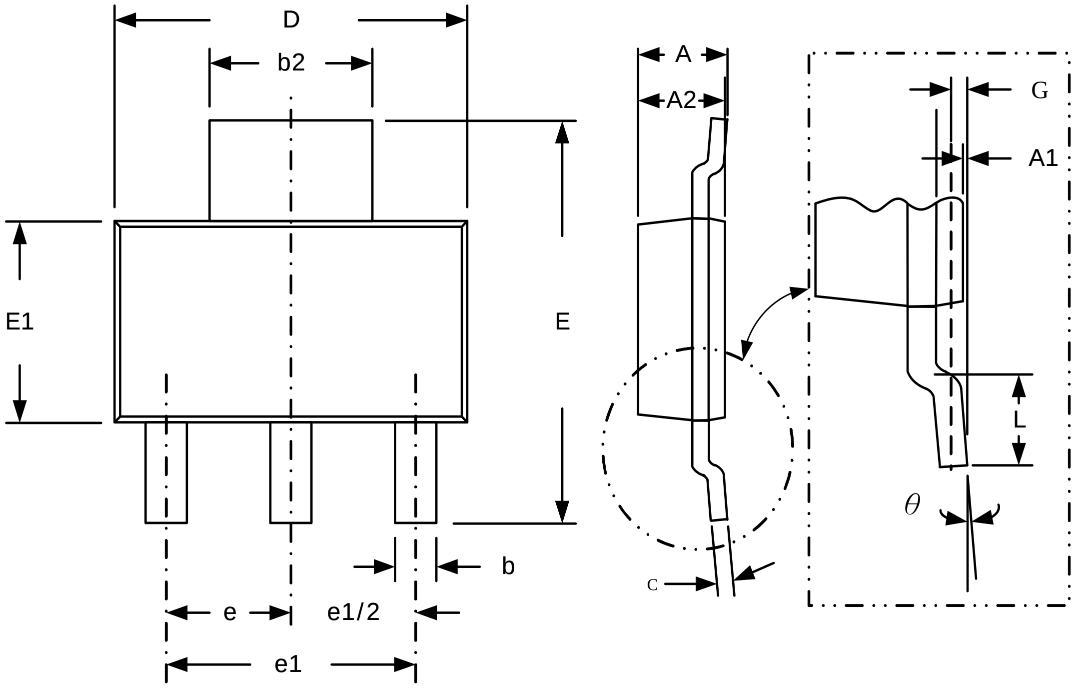
TO-252 PLASTIC PACKAGE



Dimensions

SYMBOL	Millimeters		Inches	
	MIN	MAX	MIN	MAX
A	2.18	2.39	.086	.094
A1	-	0.13	-	.005
b	0.64	0.89	.025	.035
b2	0.76	1.14	.030	.045
b3	4.95	5.46	.195	.215
C	0.46	0.61	.018	.024
C2	0.46	0.89	.018	.035
D	5.97	6.22	.235	.245
D1	5.21	-	.205	-
E	6.35	6.73	.250	.265
E1	4.32	-	.170	-
e	2.29 (TYP)		.090 (TYP)	
H	9.40	10.41	.370	.410
L	1.40	1.78	.055	.070
L1	2.74 (TYP)		.108 (TYP)	
L2	0.51 (TYP)		.020 (TYP)	
L3	0.89	1.27	.035	.050
L4	-	1.02	-	.040
L5	1.14	1.52	.045	.060
θ	0°	10°	0°	10°
θ1	0°	15°	0°	15°

SOT-223 PLASTIC PACKAGE



Dimensions				
SYMBOL	**Millimeters**		**Inches**	
	MIN	**MAX**	**MIN**	**MAX**
A	-	1.80	-	.071
A1	0.02	0.10	.001	.004
A2	1.55	1.65	.061	.065
b	0.66	0.84	.026	.033
b2	2.90	3.10	.114	.122
c	0.23	0.33	.009	.013
D	6.30	6.70	.248	.264
E	6.70	7.30	.264	.288
E1	3.30	3.70	.130	.146
e	2.30 (TYP)		.091 (TYP)	
e1	4.60 (TYP)		.181 (TYP)	
L	0.90	-	.035	-
G	0.25 (TYP)		.010 (TYP)	
θ	0°	8°	0°	8°

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